103- AND 124-TYPE AMPLIFIERS
TESTS AND INSPECTIONS

1. GENERAL

1.01 This section describes methods of testing and inspecting 103- and 124-type amplifiers used in special services such as programs, public address systems, etc. The methods cover particularly the 124-type amplifiers, but those for the 124C and 124D apply to the 103C and 103D amplifiers, respectively.

1.02 Where the provision of impedance matching pads is not practicable or justified by the amount of testing work to be done at a particular point, the characteristics of the 103C or 124C and 103D or 124D amplifiers can be checked as described in this section as an indication that the condition of the amplifier is satisfactory, but is not to be construed as the actual characteristics under operating conditions.

1.03 At the completion of any test and before returning the amplifier to service, any conditions that may have been changed for the test shall be restored to normal service arrangement and the amplifier adjusted for normal working gain.

1.04 The tests and inspections covered are:

(A) Electron Tube Tests

(B) Test for Steady Noise

(C) Microphonic Tube Test

(D) Electrolytic Condensers

(E) 1000-Cycle Gain Measurement

(F) Primary Power Voltage

(G) Power Output Adjustment

(H) Gain Frequency Measurement

(I) Operating Currents and Voltages

2. APPARATUS

2.01 The apparatus required for each test is shown in the following list. The details for each item are covered in the indicated paragraphs.

Apparatus	Paragraph	Number Required for Tests (A)	(B)	(C)	(E)	(F)	(H)	(I)
Volt-Ohm-Milliammeter	(2.02)	-	*	-	-	1	-	1
Vacuum Tube Tester	(2.03)	1	-	-	-	-	-	-
Noise Measuring Set	(2.04)	-	1	1	-	-	-	-
217D Plug	(2.05)	-	1	1	-	-	-	-
19C Oscillator	(2.06)	-	-	-	1	-	1	-
Cords	(2.07)	-	1	1	2	-	2	-
Transmission Measuring Set	(2.08)	-	-	-	1	-	1	-
Attenuator	(2.09)	-	-	-	1	-	1	-
Screwdriver	(2.10)	-	-	-	1	-	1	-
18J Resistor (30 ohms)		-	-	-	1	-	1	-
18D " (120 ohms)		-	-	-	1	-	1	-
18T " (50 ohms)		-	-	-	1	-	1	-
18GC " (575 ohms)		-	-	-	1	-	1	-
18BD " (580 ohms)		-	-	-	1	-	1	-
18GY " (540 ohms)		-	-	-	1	-	1	-
18AE " (600 ohms)		-	1	1	-	-	-	-

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2.02 KS-14510 Volt-Ohm-Milliammeter equipped with test leads or equivalent meter having a resistance of at least 1000 ohms per volt.

2.03 KS-15560-L1 Hickok Tube Tester, or equivalent.

2.04 2B Noise Measuring Set, or equivalent.

2.05 217D (600-ohm) Plug.

2.06 19C Oscillator.

2.07 Two W2BP Cords, six feet long, equipped with one 24A Plug and two 35 Cord Tips (2W15B Cord).

2.08 13A Transmission Measuring Set, or equivalent.

2.09 5A Attenuator, or equivalent. Two to be used testing the 124D Amplifier for gain when input terminals 1-3 are used.

2.10 Screwdriver "H" - Cabinet.

3. PREPARATION

Tests (B) and (C)

2B Noise Measuring Set

3.01 Calibrate the 2B noise measuring set in accordance with the instruction card on set.

Note: To avoid discharging the batteries, turn off the filament supply by pushing in the FIL key whenever the measuring set is not in use. Allow about a minute for filaments to heat after the FIL key is pulled out.

Tests (E) and (H)

19C Oscillator Calibration

3.02 Connect the oscillator power cord to a source of 105 to 125-volt 50 or 60-cycle supply.

3.03 Operate the ON switch and allow a warming up period of about ten minutes.

3.04 Connect the 18AE (600-ohm) resistor across the OUTPUT terminals and adjust the output to indicate approximately 1 mw on the meter scale.

3.05 With the KC switch operated, adjust the frequency dial until the CAL line is exactly opposite the KC index line.

3.06 Adjust the small knob designated KC until the meter indication falls to the arrow without vibration. With reasonable care this can be done to an accuracy of 1 cycle.

3.07 Operate the C switch and adjust the small knob designated C until the meter indication falls to the arrow without vibration.

3.08 Since the C adjustment has a small effect on the KC adjustment, operate the KC switch and check that the meter indication falls to the arrow without vibration. If this is not the case, repeat 3.05 to 3.07.

3.09 Turn the frequency dial to 1 kc and adjust the output control knob to give a meter indication of 1 mw.

3.10 Remove the 600-ohm resistor from the OUTPUT terminals.

3.11 Change the frequency dial for desired frequencies in Test (H).

13A Transmission Measuring Set Calibration

3.12 Connect the transmission measuring set to a source of 105 to 125-volt 50 or 60-cycle supply.

3.13 Operate the ON switch and allow a warming up period of about ten minutes.

3.14 Connect the OUTPUT terminals of the 19C oscillator to the IN terminals of the transmission measuring set by means of short lengths of wire.

3.15 With the dial switch of the 13A transmission measuring set operated to the 0 position associated with the black scale of the meter, note the indication, and if not within $\pm$ 0.1 db of 0 db on the black scale, adjust the calibrating resistance in the set by means of a screwdriver in the slot provided for this purpose, until the indication is zero.

3.16 Operate the dial switch to the step 0 designated in red and note that the indication is 0 $\pm$ 0.1 db on the red scale of the meter.

Tests (A) to (I)

Transfer of Program Network from Regular to Emergency 124B Amplifier

3.17 Before making any tests on the 124B amplifier, consult the supervisor responsible for coordinating the program network to prevent interfering with program transmission.

3.18 When permission is granted transfer the network from regular to emergency amplifier as follows:

3.19 Turn switch on the upper right-hand side of the emergency amplifier to ON.

3.20 Insert the plug at one end of a 2P13B cord in the IN line jacks of the circuit affected and the plug at the other end in the IN drop jacks of the emergency amplifier.

3.21 Insert the plug at one end of another 2P13B cord in the OUT drop jacks of the emergency amplifier and the plug at the other end in the OUT line jacks of the circuit affected.

3.22 Insert plug of the monitoring receiver cord in the OUT monitoring jack of the circuit affected. If the program is clear and can be heard with the receiver held about six inches away from the ear, it can be considered as satisfactory.

3.23 After tests are completed, consult the supervisor responsible for coordinating the network and return the regular amplifier to service.

Tests (B), (E) and (H)

3.24 When testing the 103C and 103D amplifiers as described in (B), (E) and (H), the standby relay located in the amplifier must be in the operated position. Use a locally made wooden wedge to block the armature operated with the power supply disconnected while inserting wedge.

4. METHOD

(A) Electron Tube Tests

4.01 Test each electron tube with a KS-15560-L1 Hickok tube tester or equivalent in accordance with the information given in the A700 practices covering the test set. Discard any tubes which fail to meet the requirements as given in the practices on the test set.

Note: Before removing tubes, turn down the amplifier sufficiently in advance to allow the tubes to reach a safe handling temperature.

(B) Test for Steady Noise

4.02 Measure the noise of the amplifier at the 600-ohm output, with both program and flat weighting and with gain control set for maximum gain, using the 2B noise measuring set. For these tests, the input of the amplifier should be terminated by means of the proper 18-type resistance, depending on the input arrangements used, as follows:

Table 1

Condition	Termination
124A Amplifier	
All input arrangements	18AE (600 ohms)
124B	
Terminals 1-2	18AE (600 ohms)
1-3	18AE (600 ohms)
124C and 103C	
Terminals 1-2	18T (50 ohms)
1-3	18AE (600 ohms)
124D and 103D	
Terminals 1-2	18J (30 ohms)
1-3	18D (120 ohms)
124E	
All input arrangements	18AE (600 ohms)

The following paragraph covers the 600-ohm termination of an input arrangement. If the termination is other than 600 ohms, as determined by Table 1, cross-connect the proper 18-type resistance to the input terminals which deviates from 600 ohms.

4.03 If the amplifier being tested is cross-connected to a jack field, insert the 217D plug in the AMP IN jacks of the jack field. If the amplifier is not cross-connected to a jack field, remove the cross-connection on the input terminals being used and connect the 18AE (600-ohm) resistance to the same terminals.

4.04 If the amplifier is cross-connected to a jack field, patch the AMP OUT jacks of the jack field to the IN terminals of the 2B noise measuring set, otherwise, remove the cross-connection on the output terminals being used and patch the same terminals to the IN terminals of the 2B noise measuring set by means of paired twisted wire.

4.05 Set the potentiometer of the amplifier for maximum gain.

4.06 Insert the plug of the 2B noise measuring set in the PROG jacks.

4.07 Operate the K3 key to NORMAL and if the set is equipped with an F1A-1144 key, turn the key to position stencilled 1144.

4.08 Pull out the FIL key and allow about a minute for the filaments to heat.

4.09 Adjust the DB dial on the 2B noise measuring set so that a plus reading can be obtained on the meter.

4.10 For program weighting, operate the K3 key to NORMAL. The reading of the DB dial plus the reading of the meter should not exceed the value shown in Table 2.

4.11 For flat weighting measurements, operate the K3 key to FLAT and insert dummy plugs (which are equipped with the set), in the SOUND jack. The reading of the DB dial plus the reading of the meter minus 16 should not exceed the value shown in Table 2.

4.12 The calculated reading as explained in 4.10 and 4.11 should not exceed the following values.

Table 2

Weighting	Amplifier	Key K3	Dummy Plugs	Dial Reading Plus Meter Reading	Dial Reading Plus Meter Reading Minus 16
Program	124A, B, C & E	Normal	None	45	
Flat	"	Flat	Sound		60
Program	124D	Normal	None	76	
Flat	"	Flat	Sound		85

4.13 If the noise exceeds the maximum value and can not be reduced by the procedure covered in 4.17, or by replacements of electron tubes, the electrolytic condensers should be replaced.

Note: The proper grounding of a 124-type amplifier is very important in preventing noise pickup.

(C) Microphonic Tube Test

4.14 With the 2B noise measuring set connected to the amplifier as described in 4.03 to 4.08, attach the head set (which is part of the 2B noise measuring set equipment) to the MON REC terminals.

4.15 Using an eraser attached to a pencil, tap lightly on the electron tubes one at a time. The tapping will produce noise pulses, one pulse occurring each time the tube is tapped, but any loud or sustained ponge, scratches or frying noises should be regarded as trouble and the tube should be replaced to determine if it is the source of trouble and the tapping test repeated. If the noise is not eliminated, the trouble is probably due to other causes.

4.16 If an intermittent meter deflection is observed when the tubes are not being tapped, it may be due to microphonic noise in the electron tubes or to a loose connection in the wiring or poor contact in the plugs, jacks or tube sockets.

(D) Electrolytic Condensers

4.17 The dielectric film of the electrolytic condensers will deteriorate slowly if there is no voltage impressed on the condenser terminals. Accordingly, if an amplifier has had long periods of non-use (24 months or more), it will be necessary to reform the condenser film. Section 032-110-701 covers the method used in reforming a deteriorated film. The condition of the electrolytic condensers can be determined by measuring the amplifier noise as described in (B).

(E) 1000-Cycle Gain Measurement

4.18 Patch the OUTPUT terminals of the 19C oscillator to the IN terminals of the 5A attenuator by means of short pieces of wire.

4.19 Turn all keys on the 5A attenuator so that the white line points to the loss value, thereby putting in all loss to prevent overloading the transmission measuring set.

Note: As the 124D amplifier has about 107 db gain, when using input terminals 1-3, two 5A attenuators or other suitable pads must be used to keep the input to the 13A transmission measuring set below 1 mw which is 0 db as read on the 13A transmission set meter.

4.20 If the input arrangement has an impedance of 600 ohms, as determined from Table 1, and the amplifier is cross-connected to a jack

field, patch the OUT terminals of the 5A attenuator to the AMP IN jacks of the jack field by means of a 2W15B cord. If the 600-ohm input arranged amplifier is not cross-connected to a jack field, remove the cross-connection on the input terminals being used and patch the same terminals to the OUT terminals of the 5A attenuator by means of paired twisted wire. If the input arrangement varies from 600 ohms, an impedance matching pad may be made up locally, using 18-type resistances, and connected as shown in Fig. 1.

4.21 If the amplifier is cross-connected to a jack field, patch the AMP OUT jacks of the jack field to the IN terminals of the 13A transmission measuring set by means of a 2W15B cord, otherwise, remove the cross-connection on

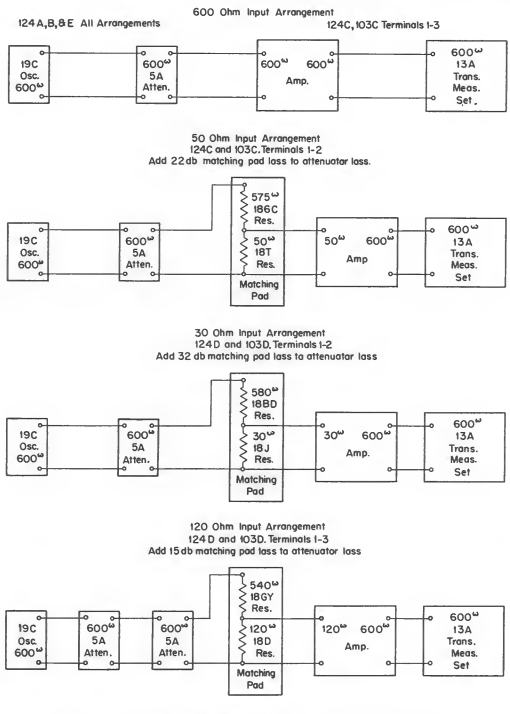


Fig. 1 - Patching Arrangements Used in Testing Amplifiers

the output terminals being used and patch the same terminals to the IN terminals of the 13A transmission measuring set by means of paired twisted wire.

4.22 Turn the gain control dial of the amplifier for maximum gain.

4.23 Set the dial of the 13A transmission measuring set on the red 0. The meter reading is obtained from the red (upper) scale.

4.24 Operate oscillator, amplifier and transmission measuring set switches to the ON position and allow the filaments about ten minutes to warm up.

4.25 Reduce the impedance of the 5A attenuator by turning keys until the meter of the 13A transmission set shows a reading on the red scale.

4.26 The gain measurement is the sum of the readings of the operated keys on the 5A attenuator plus the red scale reading of the 13A transmission measuring set.

Example: If the 13A transmission measuring set meter reads 3.2 db on the red scale with the dial at the red 0 and the 5A attenuator keys operated show the attenuation to be 42 db (representing a sending power into the amplifier of 42 db below 1 mw) the gain is 42 db plus 3.2 db or 45.2 db.

Note: When an impedance matching pad is connected to the 103C, 124C, 103D or 124D amplifiers, the db loss of the pad, as shown in Fig. 1, must be added to the 5A attenuator loss.

4.27 The gain tests described below cover all of the various input arrangements available with the 124-type amplifiers. In a particular case the test need be made only for the input arrangement actually used. All tests may be made with the 600-ohm amplifier output and a 600-ohm transmission measuring set.

124A Amplifier

4.28 Make preparations as described in 4.18 to 4.25.

4.29 With input terminals 1-3 being used the gain described in 4.26 should be 50 ± 2 db.

4.30 With the 600-ohm input terminals 1-2 being used, the gain should be 63 ± 2 db.

124B Amplifier

4.31 Make preparations as described in 4.18 to 4.25.

4.32 The gain measurement described in 4.26 should be within ± 2 db of the values shown below for the various input arrangements with the gain control of the amplifier on Step 20.

Input Arrangement	Gain db
SD-95104, Fig. A	66
B	60
C	45
D	45
E	39

4.33 Operate the gain control of the amplifier to Step 19 and measure the gain. The reduction in gain should be 2.0 ± 0.5 db. Repeat for each step on the gain control. The change in gain between any two successive steps should be 2.0 ± 0.5 db.

103C and 124C Amplifiers

4.34 Make preparations as described in 3.24 and 4.18 to 4.25.

4.35 Measure the gain using 600-ohm input terminals 1-3 with the gain control set at maximum. The gain as described in 4.26 should be 51 ± 2 db.

4.36 With the 50-ohm input terminals 1-2 being used, an impedance matching pad is connected as shown in Fig. 1. With the amplifier adjusted for maximum gain, the gain as described in 4.26 should be 58 ± 2 db. Turning the gain control to position 5, the gain should then be 20 ± 4 db lower than the maximum previously measured.

4.37 When input terminals 1-2 are being used, and the impedance matching pad is not used as described in 1.02, the test may be made employing a sending source of 600 ohms. Under these conditions the gain as described in 4.26 should be 57.5 ± 2 db. Turning the gain control to position 5, the gain should then be 20 ± 4 db lower than the maximum previously measured.

103D and 124D Amplifiers

4.38 With the 30-ohm input terminals 1-2 being used, an impedance matching pad is connected as shown in Fig. 1. Due to the high gain of the 124D amplifier and the possibility of damaging the 13A transmission measuring set,

when using the 120-ohm input terminals 1-3 of the amplifier, connect two 5A attenuators and a matching pad as shown in Fig. 1.

4.39 With either input arrangement being used and preparations made as covered in 3.24, 4.25 and 4.28 and with the amplifier adjusted for maximum gain, the gain as described in 4.26 should be 107 ± 2 db. Turning the gain control to position 5, the gain should then be 20 ± 6 db lower than the gain previously measured.

4.40 When the impedance matching pad is not used as described in 1.02, measure the 1000-cycle gain using input terminals 1-3 with the gain control set for maximum gain employing a sending source impedance of 600 ohms. Under these conditions, the gain should be 115 ± 2 db. Turn the gain control to position 5. The gain should then be 20 ± 6 db lower than the maximum gain previously measured.

124E Amplifier

4.41 Make preparations as described in 4.18 to 4.25.

4.42 With the amplifier adjusted for maximum gain the gain as described in 4.26 should be within ± 2 db of the values given below for the various input arrangements.

Input Arrangement	Gain - db
No. 1 Term. 1-3	50
No. 1 " 1-2	63
No. 2 " 5-6 (Strap 7 & 1) (Strap 9 & 3)	30
No. 3 Term. 11-12 (Strap 7 & 1) (Strap 8 & 2)	43

4.43 Operate the gain control of the amplifier to Step 19 and measure the gain. The reduction in gain should be 2.0 ± 0.5 db. Repeat for each step on the gain control. The change in gain between any two successive steps should be 2.0 ± 0.5 db.

(F) Primary Power Voltage

4.44 The 124-type amplifiers are designed to operate directly from a 105-125-volt, 50-60-cycle a-c power supply. If the amplifier is not showing proper gain as determined in (E) make the following tests:

4.45 Measure the commercial power voltage at the fuse panel or other convenient point between the fuse panel and the amplifier using the 150 a-c volt scale on the KS-14510 volt-ohm-milliammeter or suitable voltmeter. If the voltage is within the range of 105 to 115 volts, the supply should be connected to terminals L1 and L2 on the terminal strip associated with the power transformer (T3); if it is within the range of 115 to 125 volts, the supply should be connected to terminals L1 and L3.

Caution: In making these measurements, proper care should be taken to avoid contact with live terminals.

(G) Power Output Adjustment

4.46 The 124-type amplifiers are normally wired with the two orange leads from the power transformer connected to the plate terminals of vacuum tube socket VS5. Where the circuit order or service order calls for the high power output, remove the orange leads from the plate terminals of VS5, tape the ends securely and move them out of the way. Remove the tape protection from the red leads and connect them to the plate terminals of VS5.

Note: This work must be done with the power turned off.

(H) Gain Frequency Measurement

124A Amplifier

4.47 Make preparations as described in 4.18 to 4.25.

4.48 Turn the frequency dial of the 19C oscillator to the frequency indications of 35, 100, 1000, 5000 and 8000 cycles and note that the deviation for any frequency setting does not exceed ± 1.0 db from the 1000-cycle gain measurement determined in 4.29 or 4.30.

124B Amplifier

4.49 Make preparations as described in 4.18 to 4.25.

4.50 Set the gain control of the amplifier on Step 20.

4.51 Turn the frequency dial of the 19C oscillator to the frequency indications of 35, 100, 1000, 5000, 8000 cycles and, if practicable, 10,000 cycles and note that the deviation for any frequency setting does not exceed ± 1.6 db from the 1000-cycle gain measurement determined in 4.32 for any input arrangement used.

103C and 124C Amplifiers

4.52 Make preparations as covered in 3.24 and 4.18 to 4.25.

4.53 Use input terminals 1-2 to check that breathing noises below 1000 cycles are attenuated when the amplifier works out of a carbon transmitter. With the 50-ohm input terminals 1-2 being used, an impedance matching pad is connected as shown in Fig. 1.

4.54 With the amplifier set for maximum gain, turn the frequency dial of the 19C oscillator to the frequencies indicated below, and note that the deviation for any frequency setting does not exceed the 1000-cycle gain measurement determined in 4.35 for the 600-ohm input terminals 1-3 or in 4.36 for the 50-ohm input terminals 1-2 as follows:

Frequency	Deviation in Gain	
	Terminals 1-3	Terminals 1-2
100	0 ± 1.0 db	-10 ± 2.0 db
300	0 ± 1.0 db	-2.5 ± 1.0 db
5000	+1.0 ± 1.0 db	+1.5 ± 1.0 db

4.55 When input terminals 1-2 are being used, and the impedance matching pad is not used as described in 1.02, the test may be made employing a sending source of 600 ohms. Measure the gain using input terminals 1-2 and a 600-ohm source with the gain control set for maximum gain at frequencies of 100, 300, 1000, and 5000 cycles. The deviation in gain from the 1000-cycle value determined in 4.37 should be:

Frequency	Deviation in Gain
100	-7.8 ± 2 db
300	-1.5 ± 1 db
5000	+1.4 ± 1 db

103D and 124D Amplifier

4.56 Make preparations as covered in 3.24, 4.18 to 4.25 and 4.38.

4.57 Adjust the amplifier for maximum gain.

4.58 Turn the frequency dial of the 19C oscillator to the frequencies of 100, 300, 1000 and 5000 cycles and note, when using 30-ohm input terminals 1-2 or 50-ohm input terminals 1-3 that the deviation for any frequency setting does not exceed the 1000-cycle gain measurements determined in 4.39 by ± 1.0 db.

4.59 When the impedance matching pad is not used as described in 1.02, measure the gain using input terminals 1-3 and a 600-ohm source with the gain control set for maximum gain at frequencies of 100, 300, 1000 and 5000 cycles. The deviation in gain from the 1000-cycle value determined in 4.40 should be:

Frequency	Deviation in Gain
100	-1 ± 1 db
300	0 ± 1 db
5000	-3.4 ± 1 db

124E Amplifier

4.60 Make preparations as covered in 4.18 to 4.25.

4.61 Set the gain control of the amplifier on Step 20.

4.62 Turn the frequency dial of the 19C oscillator to the frequency indications of 35, 100, 1000, 5000 and 8000 cycles and note that the deviation for any frequency setting does not exceed ± 1.0 db from the 1000-cycle gain measurement determined in 4.42 for any input arrangement used.

(I) Operating Currents and Voltages

4.63 In connection with locating troubles within the amplifier, the operating currents and voltages of various parts can be checked in accordance with the information included in Figs. 2 and 3. Make these tests with a volt-ohm-meter having a resistance of at least 1000 ohms per volt.

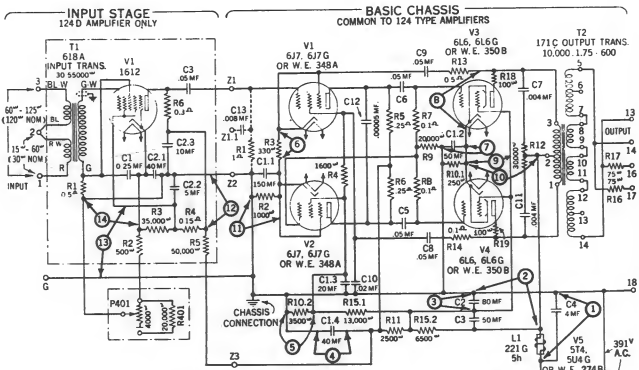
> Caution: In making these tests, care should be taken to avoid contact with line terminals since the normal operating voltages at various points in the amplifier may be as high as 460 volts.

4.64 Remove the potentiometer knob and the front mat of the amplifier panel by removing the four screws at the corners of the chassis.

4.65 Measure the voltage and current at the numbered points as shown in Figs. 2 and 3.

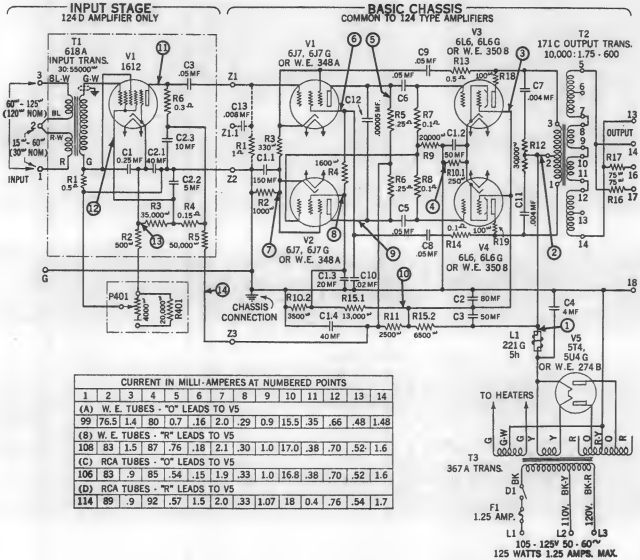
5. REPORTS

5.01 The required record of these tests should be entered on the proper form.



VOLTAGE AT NUMBERED POINTS													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
(A) W. E. TUBES - "O" LEADS TO V5													
403	384	254	250	52	2.3	19	355	234	365	2.0	168	16	.74
(B) W. E. TUBES - "R" LEADS TO V5													
440	420	276	270	55	2.4	22	385	255	395	2.1	182	18	.80
(C) RCA TUBES "O" LEADS TO V5													
430	412	276	272	55	2.1	20	380	255	390	1.9	182	18	.80
(D) RCA TUBES - "R" LEADS TO V5													
462	442	300	294	60	2.2	22	408	275	420	2.0	192	18.3	.85

Fig. 2



CURRENT IN MILLI-AMPERES AT NUMBERED POINTS													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
(A) W. E. TUBES - "O" LEADS TO V5													
99	76.5	1.4	80	0.7	.16	2.0	.29	0.9	15.5	.35	.66	.48	1.48
(B) W. E. TUBES - "R" LEADS TO V5													
108	83	1.5	87	.75	.18	2.1	.30	1.0	17.0	.38	.70	.52	1.6
(C) RCA TUBES - "O" LEADS TO V5													
106	83	.9	85	.54	.15	1.9	.33	1.0	16.8	.38	.70	.52	1.6
(D) RCA TUBES - "R" LEADS TO V5													
114	89	.9	92	.57	1.5	2.0	.33	1.07	18	0.4	.76	.54	1.7

Fig. 3